Claims

[c1] 1.A method for embossing a surface of a polymer composition having a first glass transition temperature (T_{g1}), the method comprising:
embossing the surface at temperature T_{emb}; and
altering the T_{g1} of the surface to provide a second glass transition temperature (T_{g2}), wherein the altering is during embossing, after embossing, or both during and
after embossing.

[c2] 2.The method of claim 1, wherein the polymer compostion comprises thermoplastics, thermosets, blends of thermoplastics, blends of thermosets, or blends
of thermoplastics with thermosets.

[c3] 3.The method of claim 2, wherein the polymer is a thermoplastic selected from the group consisting of polyvinyl chloride, polyolefins, polyethylene, chlorinated
polyethylene, polypropylene, polyesters, polyethylene terephthalate, polybutylene
terephthalate, polycyclohexylmethylene terephthalate, polyamides, polysulfones,
hydrogenated polysulfones, polyimides, polyether imides, polyether sulfones, polyphenylene sulfides, polyether ketones, polyether ether ketones, ABS resins, polystyrenes, hydrogenated polystyrenes, syndiotactic and atactic polystyrenes, polycyclohexyl ethylene, styrene-co-acrylonitrile, styrene-co-maleic anhydride, polybutadiene, polyacrylates, polymethylmethacrylate, methyl methacrylate-polyimide
copolymers, polyacrylonitrile, polyacetals, polycarbonates, polyphenylene ethers,
ethylene-vinyl acetate copolymers, polyvinyl acetate, liquid crystal polymers, ethylene-tetrafluoroethylene copolymer, aromatic polyesters, polyvinyl fluoride, polyvinylidene fluoride, polyvinylidene chloride, polytetrafluoroethylene, and combinations comprising at least one of the foregoing thermoplastics.

[c4] 4. The method of claim 2, wherein the polymer is a thermoplastic blend selected from the group consisting of acrylonitrile-butadiene-styrene/nylon, polycarbonate/acrylonitrile-butadiene-styrene, acrylonitrile butadiene styrene/polyvinyl chloride, polyphenylene ether/polystyrene, polyphenylene ether/nylon, polysulfone/acrylonitrile-butadiene-styrene, polycarbonate/thermoplastic urethane, polycarbonate/polyethylene terephthalate, polycarbonate/polybutylene terephthalate, thermoplastic elastomer alloys, nylon/elastomers, polyester/elastomers, polyethylene terephthalate/polybutylene terephthalate, acetal/elastomer, styrene-maleic anhydride/acrylonitrile-butadiene-styrene, polyether etherketone/polyethersulfone, polyimide/polysiloxane, polyetherimide/polysiloxane, polyethylene/nylon, polyethylene/polyacetal, and combinations comprising at least one of the foregoing blends of thermoplastic polymers.

[c5] 5. The method of claim 2, wherein the polymer is a thermoset selected from the group consisting of epoxy, phenolics, alkyds, polyesters, polyurethanes, silicone polymers, mineral filled silicones, bis-maleimides, cyanate esters, vinyl, benzocyclobutene polymers, and combinations comprising at least one of the foregoing thermosetting polymers.

[c6] 6.The method of claim 1, wherein the polymer is selected from the group consisting of polyimides, polyetherimides, copolymers of polyimides, copolymers of polyetherimides, and blends comprising at least one of the foregoing polymers.

[c7] 7.The method of claim 6, wherein the polymer composition comprises reactive moieties selected from the group consisting of vinyl substituted

aromatic

monoamines, polyfunctional alkenyl aromatic monomers, acryloyl monomers, sulfides, toluidines, ethynyl groups, ethyl groups, ethenyl groups, epoxies, fluoroolefins, alkoxysilanes, and combinations comprising at least one of the foregoing reactive moieties.

[c8] 8.The method of claim 6, wherein the polymer comprises about 0.1 to about 30 wt.% reactive moieties, based on the total weight of the polymer.

[c9] 9.The method of claim 6, wherein the polymer composition further comprises a perfluorocarbon.

[c10] 10.The method of claim 6, wherein Tg2 is greater than Temb.

[c11] 11.The method of claim 6, wherein Tg2 is greater than Tg1.

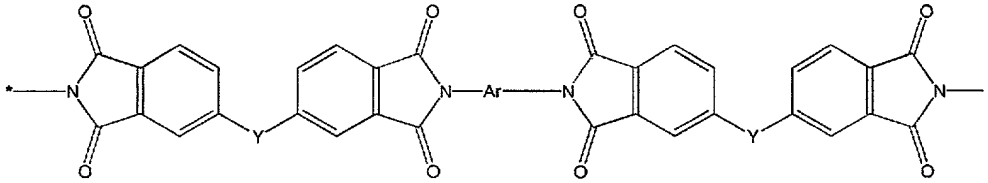
[c12] 12.The method of claim 6, wherein the polymer comprises a reactive plasticizer having the structural formula A-R-A wherein A is a reactive functionality

selected from the group consisting of vinyl substituted aromatic monoamines, polyfunctional alkenyl aromatic monomers, acryloyl monomers, sulfides, toluidines,

ethynyl groups, ethyl groups, ethenyl groups, epoxies, fluoroolefins, alkoxysilanes,

and combinations comprising at least one of the reactive functionalities and R is a

monomeric or oligomeric polyimide repeat unit shown in the formula (XVIII)

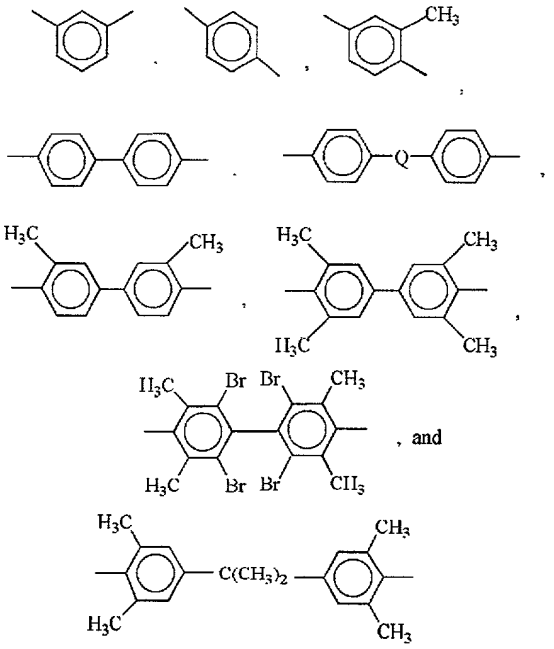


(XVIII)

herein Y is -O- or a group of the formula -O-Z-O- wherein the divalent bonds of the

-O- or the -O-Z-O- group are in the 3,3', 3,4', 4,3', or the 4,4' positions, and wherein Z

comprises divalent radicals of formula (III)

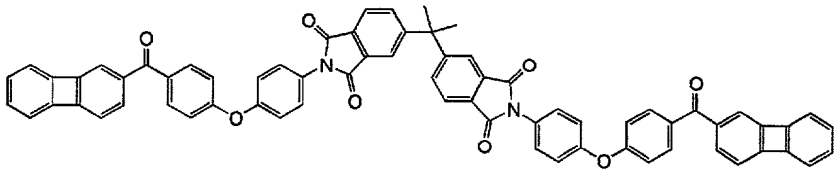


(III)

w herein n is an integer from 0 to about 5 and Ar is an aromatic group comprising

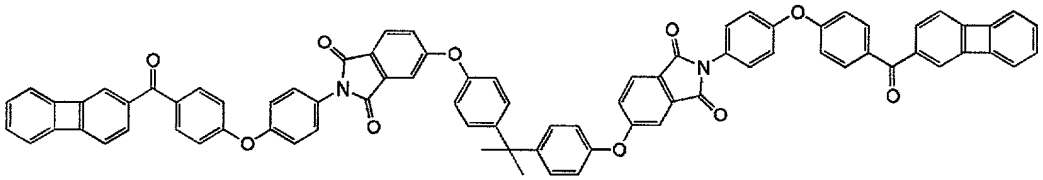
reactive diamines.

[c13] 13. The method of claim 6, wherein the polymer comprises a reactive plasticizer selected from the group having the structural formula XIXa, XIXb, XIXc,

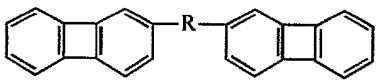


(XIXa)

o



(XIXb)



(XIXc)

r combinations comprising at least one of XIXa, XIXb, XIXc, wherein R is an moiety having about 36 to about 60 carbon atoms.

[c14] 14.The method of claim 13, comprising about 5 to about 25 wt% reactive

plasticizer, based on the total weight of the composition.

[c15] 15. The method of claim 6, wherein the polyimide, polyetherimide, copolymer of polyimide, or copolymer of polyetherimide has one or more of fluorine
atoms, silicon atoms, or siloxane segments.

[c16] 16. The method of claim 6, wherein the polymer composition further comprises polyamic acid.

[c17] 17.A method for the manufacture of an embossed polymer surface, which comprises:
embossing a surface comprising a polymer and a plasticizer having reactive moieties; and
reacting the reactive moieties to increase the glass transition temperature of the embossed polymer surface.

[c18] 18.The method of claim 17, wherein the polymer surface comprises a thermoplastic selected from the group consisting of polyimides, polyetherimides,
copolymers of polyimides, copolymers of polyetherimides, blends of polyimides with
perfluorocarbons, blends of polyetherimides with perfluorocarbons and combinations
comprising at least one of the foregoing thermoplastics.

[c19] 19.The method of claim 17, wherein the polymer comprises a reactive plasticizer in an amount effective raise the glass transition temperature of the polymer
after crosslinking.

[c20] 20. The method of claim 17, wherein the p0olymer comprises reactive moieties selected from the group consisting of vinyl substituted aromatic monoamines, polyfunctional alkenyl aromatic monomers, acryloyl monomers, sulfides, toluidines, ethynyl groups, ethnyl groups, ethenyl groups, epoxies, fluoroolefins, alkoxysilanes, and combinations comprising at least one of the

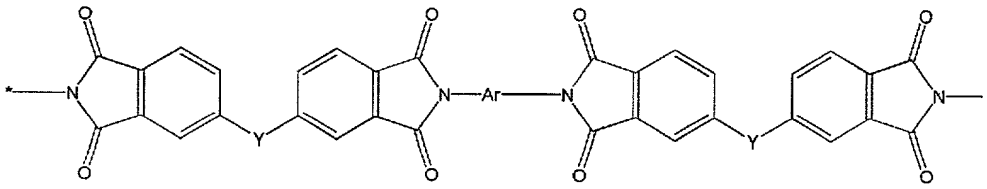
foregoing reactive moieties.

[c21]

21. The method of claim 17, wherein the polymer comprises reactive plasticizer having the structural formula A-R-A where A is a reactive functionality

selected from the group consisting of vinyl substituted aromatic monoamines, polyfunctional alkenyl aromatic monomers, acryloyl monomers, sulfides, toluidines,

ethynyl groups, ethnyl groups, ethenyl groups, epoxies, fluoroolefins, alkoxysilanes, and combinations comprising at least one of the reactive functionalities and R is a monomeric or oligomeric polyimide repeat unit shown in the formula

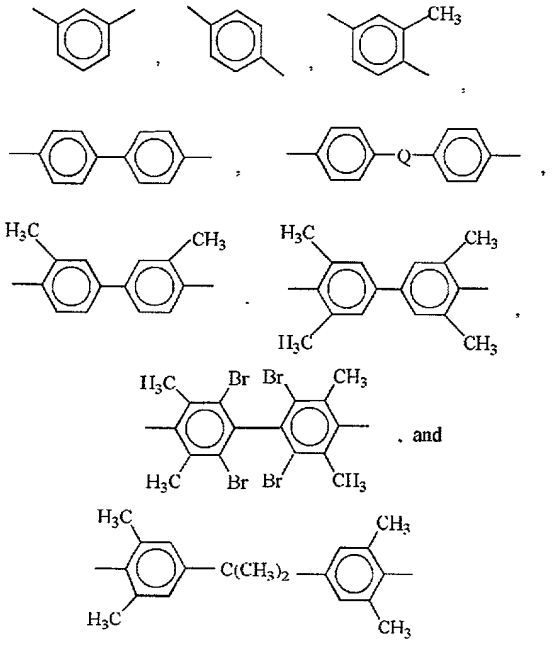


(XVIII)

Ywherein is -O- or a group of the formula -O-Z-O- wherein the divalent bonds of the -O- or

the -O-Z-O- group are in the 3,3', 3,4', 4,3', or the 4,4' positions, and wherein Z

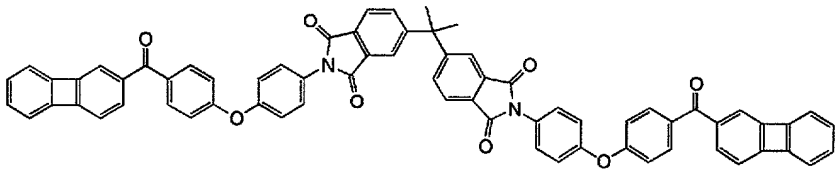
comprises divalent radicals of formula (III)



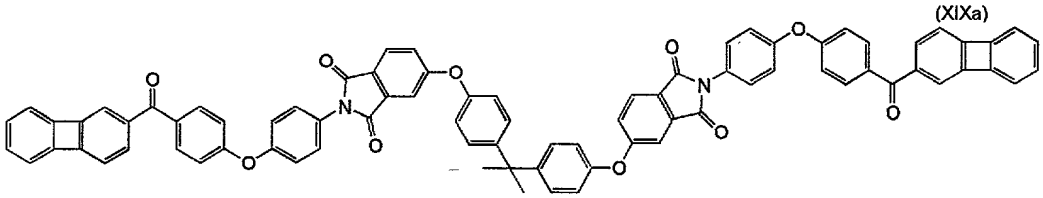
(III)

n is an integer from 0 to about 5 and Ar iss an aromatic group comprising reactive diamines.

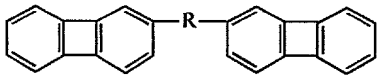
[c22] 22. The method of claim 17, wherein the polymer comprises a reactive plasticizer selected from the group having the structural formula XIXa, XIXb, XIXc:



(XIXa)



(XIXb)



(XIXc)

wherein R is a moiety having aromatic groups and from 36 to 60 carbon atoms.

[c23] 23. A method for the manufacture of an embossed polymer surface, which comprises:

embossing a surface comprising the reaction product of m-phenylenediamine and a dianhydride; and

treating the embossed polymer to increase the glass transition temperature of the embossed polymer.

[c24] 24. The method of Claim 23, wherein the dianhydride is selected from the group consisting of bisphenol A dianhydride, 4,4'-oxydiphthalic anhydride, hexafluoroisopropylidene diphthalic anhydride, and combinations comprising at least

one of the foregoing dianhydrides.

[c25] 25. The method of Claim 23, wherein an amine terminated siloxane is further added to the reaction product of m-phenylenediamine and the dianhydride.

[c26] 26. The method of Claim 23, wherein polyamic acid is further added to the reaction product of m-phenylene diamine and the dianhydride.

[c27] 27.The method of claim 23, wherein the polymer surface comprises reactive moieties selected from the group consisting of vinyl substituted aromatic
monoamines, polyfunctional alkenyl aromatic monomers, acryloyl monomers, sulfides, toluidines, ethynyl groups, ethnyl groups, ethenyl groups, epoxies, fluoroolefins, alkoxysilanes, and combinations comprising at least one of the foregoing reactive moieties.

[c28] 28. The method of claim 23, wherein the polymer comprises a reactive plasticizer.

[c29] 29. An article formed by the method of claim 1.

[c30] 30.An article formed by the method of claim 17.

[c31] 31.An article formed by the method of claim 23.